Advanced Metallurgical Research

Program Mission

The Advanced Metallurgical Processes program conducts inquiries, technological investigations, and research concerning the extraction, processing, use, and disposal of mineral substances under the mineral and materials science program at the Albany Research Center (ARC) in Oregon.

Program Strategic Performance Goal

The program's goal is to create public benefits by carrying out long-term, high risk research on materials that are key to the energy industry. Projects are focused on areas where there are large potential public benefits, but where industry would not invest on its own. The program addresses the full life cycle of materials production and cost-effective processing of improved materials through to their disposal and recycling. For example, the program seeks to determine the factors that limit service life of materials in industrial, structural, or engineering applications and to provide solutions to service-life problems through new materials technology. This is an area where the benefits to any single firm may be too low to attract investment, but will sum to large economic improvements if applied throughout the economy.

Another focus is to develop and demonstrate technologies that will create public benefits by reducing waste and pollution. For example, for the last four years the Program has sought ways to sequester CO_2, a greenhouse gas, by converting it to a stable mineral form; such a process, if proved practical and economic, could contribute to Fossil Energy's goal of a zero emission power plant. Thus, the research at ARC directly contributes to Fossil Energy's objectives by providing information on the performance characteristics of materials being specified for the current generation of power systems, on the development of cost-effective materials for inclusion in Vision 21 systems, and for solving environmental emission problems related to fossil fired energy systems. The program at ARC stresses full participation with industry through partnerships and emphasizes cost sharing to the fullest extent possible.

Performance Indicator

- Demonstrate the development of two cost-effective materials for inclusion in Vision 21 systems developed by the Advanced Metallurgical Processes Program for advanced power systems' applications by obtaining agreements with private and public sector organizations and conducting performance tests in actual full scale systems.

- Provide solutions to environmental emission problems related to fossil energy systems. Reduce projected total process costs for CO_2 sequestration via the formation of mineral carbonates by 10 percent.

- The research at ARC directly contributes to Fossil Energy's objectives by providing information on the performance characteristics of materials being specified for power systems. The Program will publish 15 articles in referred journals, 15 articles in proceedings of National and International

Conferences, and 10 technical reports based upon the research conducted.

- The program at ARC stresses full participation with industry through partnerships and will establish 10 cooperative agreements in FY 2004.

Annual Performance Targets and Results

FY 2002 Results	FY 2003 Updated Targets	FY 2004 Targets
Note: Annual targets for Advanced Metallurgical Research were not proposed prior to FY 2003.	Complete laboratory proof-of-concept testing of ARC developed refractory, and place test panels of the refractory in a commercial gasifier utilizing coal as the primary feedstock. Complete acquisition of engineering data from operation of Prototype I flow-through mineral carbonation reactor, and design a second prototype reactor based on these results. Develop test method for conducting high-temperature, dual environment testing of corrosion-resistant alloys to serve as interconnects in solid oxide fuel cells.	Identify and obtain agreement with a private sector organization to insert 15 refractory bricks into the liner of a single commercial slagging gasifiers that utilizes coal as the primary feedstock over a 6 month period. Refractories for public utility systems constitute less than 1 percent of all refractories produced, with coal gasification systems comprising only a small part of this total. With less than a handful of slagging coal gasifiers for power production in the United States, refractory manufacturers have little incentive to develop materials for a coal gasifier market. Gasifier users identified refractory service life as *the* most important limitation to on-line availability, and an on-line availability greater than 90 percent needed for widespread commercialization. In collaboration with partners in the refractory industry, develop and produce refractory bricks that have demonstrated at least double average current performance with lifetimes of 3 years for slagging gasifier applications. Develop methods that are

FY 2002 Results	FY 2003 Updated Targets	FY 2004 Targets
		economically and technically feasible for the sequestration of CO_2 as mineral carbonates. Focus research activities to address the technical, economic, and environmental concerns related to mineralization of CO_2. Construct a Prototype II continuous bench scale mineral carbonation reactor. Operate the system during a 2 month period and produce 10,000 kg of product for environmental and potential by-product characterization. Complete the bench scale demonstration of the potential for in-situ mineral carbonation on bulk Columbia River Basalt Group (CRBG) samples. Develop and produce a metallic interconnect material which reduces current materials' costs by 80 percent, has at least 25,000 hours of service lifetime, and meets all mechanical and electrical properties for solid state fuel cell applications up to 800^0 C. Produce a 50lb ingot of a candidate material rolled into 30 to 60 feet of sheet material for prototype testing. Evaluate potential for prototype micro-channel reactors with embedded catalyst-coated membranes in reformer and/or hydrogen filter applications. Conduct a minimum of 10 tests on a single optimized substrate/ coating configuration with the goal of producing 2 prototypes

FY 2002 Results	FY 2003 Updated Targets	FY 2004 Targets
		for additional testing.

Funding Profile

(dollars in thousands)

	FY 2002 Comp. Approp.	FY 2003 Request	FY 2004 Base	FY 2004 Request	FY 2004 Request vs. Base	
					$ Change	% Change
Advanced Metallurgical Research	5,200	5,300	5,300	10,000	4,700	88.7%
Total, Advanced Metallurgical Research	$5,200	$5,300	$5,300	$10,000	$4,700	88.7%

Funding by Site

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	$Change	%Change
All Other	5,200	5,300	10,000	4,700	88.7%
Total, Advanced Metallurgical Research	$5,200	$5,300	$10,000	$4,700	88.7%

Site Description

All Other

The Department's Advanced Metallurgical Research program, within the Fossil Energy and Development program, currently funds research at the Albany Research Center (ARC), located in Albany, Oregon. ARC is a DOE-owned and operated laboratory authorized to conduct Advanced Metallurgical Processes research. ARC's function is to conduct research in support of FE programs with the aim of developing, testing, and transferring advanced materials technologies for energy systems.

Detailed Program Justification

(dollars in thousands)

	FY 2002	FY 2003	FY 2004
Advanced Metallurgical Research	**5,200**	**5,300**	**10,000**
■ **Advanced Metallurgical Processes**	5,148	5,247	9,900

Continue research to contribute to Fossil Energy's Vision 21 Systems by extending component service lifetimes through the improvement and protection of current materials, by the design of new materials, and by defining the service operating conditions for new materials in order to ensure their safe and effective use. Emphasis is placed on high-temperature erosion testing and modeling in environments anticipated for Vision 21 concepts, on the development of

sulfidation/oxidation resistant materials, and development and repair of refractory materials, for coal gasifiers. The Albany Research Center will participate in an effort to develop, fabricate and evaluate the performance of materials to be used in solid oxide fuel cell applications. These could include metallic interconnects, seals, heat exchanger materials and reformer materials to support the Solid State Energy Conversion Alliance's (SECA's) goal of significantly reducing the cost of producing commercial, environmentally friendly solid oxide fuel cells. Continue research focused on developing an economically and environmentally acceptable integrated process for disposal of carbon dioxide. Emphasis is placed on mineral carbonation to improve the kinetics and to address total system issues such as engineering feasibility, system costs, and the impact of the total approach on the true net environment impact. *Participants include: ARC.*

FY 2003 and FY 2002 funding continued development of advanced refractories for IGCC applications, CO_2 sequestration via mineral carbonation, advanced austenitic steels, and microchannel reactors for reformer and heat exchanger applications. *Participants included: ARC*

(dollars in thousands)

	FY 2002	FY 2003	FY 2004
■ **Program Support**	52	53	100
Fund technical and program management support.			
Total, Advanced Metallurgical Research	**5,200**	**5,300**	**10,000**

Explanation of Funding Changes

	FY 2004 vs. FY 2003 ($000)
■ Increase in Advanced Metallurgical Processes due to initiation of fuel cell and in-situ mineral carbonation research efforts	4,653
■ Program Support	47
Total Funding Change	**4,700**